CURRENT LITERATURE

BOOK REVIEWS

Plant breeding

PROFESSOR DEVRIES has contributed a most interesting volume[1] to the literature of plant breeding and its relations to the current theories of evolution. It is a compact and popular presentation of the recent wonderful development in methods of plant breeding, and a clear statement of the bearing of all this vast experimental work upon the author's theory of mutation. Of special interest to American readers are the description of the methods and the results obtained at the Swedish station at Svalöf under NILSSON, and the comments upon the work of BURBANK. The work of the former will come to many as a revelation, and the work of the latter will be better understood.

The material of the book is derived chiefly from a series of lectures given during two summers at the University of California and the University of Chicago. It is presented under a series of topics, each of which is complete in itself, but all of which contribute to the general purpose of the author, as expressed above. This accounts for a certain amount of repetition, but it is the kind of repetition that uses the same material to illustrate the various points of view involved in a great conception. It is difficult to give an adequate idea of the contents of such a book, for the principles become convincing only when illuminated by the details of experimental work.

The first topic, entitled "Evolution and mutation," is a general introductory definition of the mutual relations of evolution, natural selection, and mutation, relations that seem to be persistently misunderstood. Unit-characters, as the essential feature of mutation, are defined; and hybridization is shown to result, not in new unit-characters, which characterize mutation, but simply in a new combination of unit-characters. This position is supported, not only by the author's experiments, but by numerous cases in horticulture, by the constancy of wild species, by the behavior of characters in crosses, by the occurrence of clearly defined small species within the ordinary species of wild plants and agricultural crops. It is claimed that the slow change of one species into another has not been proved, and that the mass of present evidence points to the origin of species from other species by "sudden leaps," which are called mutations.

The second topic deals with "The discovery of the elementary species of agricultural plants by HJALMAR NILSSON," whose work the author evidently

[1] DEVRIES, HUGO, Plant-breeding; comments on the experiments of Nilsson and Burbank. Pp. xiii+360. Chicago: The Open Court Publishing Co. 1907.

regards as of the deepest significance, not only in practical plant breeding, but chiefly in reference to evolutionary doctrine. To develop the importance of NILSSON'S work clearly, the author considers the general topic in four sections. The first is a historical sketch of the "Different principles in the breeding of cereals," in which the contributions of LECOUTEUR, SHIRREFF, HALLETT, HAYS, and VON LOCHOW are considered. The first two worked upon the principle of a single initial selection and subsequent rapid multiplication without further selection, in this sense being the precursors of the Svalöf method. Then came the domination of HALLETT, whose principle was accepted by German breeders, and seems to govern them to this day. Its two essential features are the initial choice, and the slow and gradual improvement by selection. With great force the author shows that all depends upon initial choice, subsequent selections only serving to isolate the deviating types; and these "initial choices" were never numerous. It is significant that DARWIN'S theory of natural selection, based inferentially upon artificial selection, was developed at a time when this so-called "German method" prevailed, and the emphasis was being laid upon the continuous selection rather than upon the initial choice. The second section describes "The Swedish Agricultural Experiment Station at Svalöf." It began with the German conception of plant breeding, but soon changed to its present ideas. The results have shown that ordinary cultivated varieties of cereals are not pure, but are mixtures of well-defined and very numerous types; that when there is so great a range of types for selection, there is only loss of time in gradual amelioration by so-called methodical selection or in hybridization to secure new varieties. The third section presents "The Svalöf method of producing improved races," being a detailed account of the method of selection developed by NILSSON and his staff. Elementary forms are distinguished by definite "marks" (botanical characters) that have been found to be associated with certain industrial qualities. The selection is made only once, and the form is found to be quite uniform and constant, with the exception of accidental hybrids, which, however, also yield constant and pure races after repeated selection. The high variability which is commonly attributed to the ordinary varieties of cereals consists only in the differences among the constituents of the mixtures. The fourth section is "A criticism of the principles of continuous selection," and is a most effective analysis of the bearing of NILSSON'S work upon the question of the origin of species by natural selection or by mutation. According to the author, the idea of unit-characters has changed the whole point of view, and the theory of mutation is supported by the general occurrence of elementary species and their constancy, by a comparison of the value of fluctuating variability and mutability among cereals, and by the researches of NILSSON. He goes so far as to claim that "the victory of the theory of a saltatory origin of species can no longer be doubted."

The third general topic is "On corn breeding," and it is most interesting to read the comments of a trained European plant breeder upon the methods of breeding used in connection with this dominant cereal of the United States. The real breeding of corn began about ten years ago, with the discovery of the

principle of single-ear selection, started by HOPKINS of the University of Illinois. The main difference in the breeding of corn and other cereals is that among the latter cross-pollination is an exception, while with corn it is the rule, and repeated selection becomes necessary to eliminate the effects of previous crosses (not for slow improvement, as commonly supposed). One catches glimpses of the immense possibilities in breeding corn, as well as the amateurishness of our current methods.

The fourth topic is entitled "The production of horticultural novelties by Luther Burbank," who has the misfortune of being both overestimated and underestimated. No one is better equipped than DEVRIES, through training and temperament, to reach a true estimate, and hence this section of the volume is of great interest. The topic is presented under four divisions, the first dealing with "Methods and material." BURBANK is described as "a man who devotes his whole life and all his energies to the introduction and production of new, beautiful, and useful horticultural plants," and who has rediscovered many of the practices more or less universally known in Europe. A special feature of his work is the large scale on which his selections are made; and his main work consists in the production of new horticultural varieties by crossing, getting combinations of desirable qualities, and eliminating undesirable ones. The second section gives details of the conspicuous "New varieties of fruits and flowers" originated by BURBANK. There is an analysis of the simpler methods of producing what are called "new varieties" in horticulture, with illustrations from some of BURBANK'S most notable achievements, so far as the author could get at the scientific side of his performances by questioning. The general conclusion to be drawn from his operations is that combinations of characters can be obtained by crosses in almost any arbitrarily chosen direction or degree, but that new unit-characters are probably never produced. The third section deals with "Hybridization and selection" as practiced by BURBANK. The aim of the hybridizer is to upset the constancy of his plants and produce an extreme chaos of forms, from which his selections may be made. To get the real pedigree of any plant in this chaos is impossible, and the hybridizer does not care, for he is only after the results. BURBANK is credited with "a special gift of judgment" in his selections, but his results are new combinations of characters and not the production of new characters. All such practical hybridizing and selection "afford highly valuable resources for theoretical discussion, but on single points they should not be accepted as definite proofs, but only as indications for more circumscribed experiments." The last section, entitled "Mutations in horticulture," shows that most new horticultural varieties originate as "chance seedlings," many illustrations from BURBANK'S work being used to show that it is the occasional "chance plant" with some peculiar character that has been seized upon and propagated. It would seem, therefore, that mutations in horticulture have been frequent.

The very important fifth topic is "The association of characters in plant breeding," and it is presented in five sections. The first discusses "Association of characters in nature," and shows that there is a regular coincidence of marks

hitherto regarded as independent of one another, as the association of the color and hairs of the leaves of the seedlings of common stock with double flowers; of the characters of the foliage of the quince with the qualities of the fruit; of the form and hairiness of the scales of barley with the practical qualities of the grain. The author believes that a discovery of the laws governing such "correlations" may give us a certain amount of power over them that will prove of immense practical and experimental importance. The second section illustrates "Correlations in agricultural breeding," and it is stated that "to the practical breeder it shows the way in nearly all the burning questions, and for the scientist it may give the solution of numerous problems which have eluded his evolutionary speculations for more than half a century." The third section, entitled "A methodical study of correlations," describes in detail the remarkable system of records developed at Svalöf to keep track of all the marks and their associations. It is called "a model of the combination of science and practice." The fourth section deals with "Correlations in fluctuating variability," and is a theoretical discussion of the influence of external life-conditions on the phenomena of correlation, illustrations being taken from teratology and from agricultural plants. The cause of this parallelism between different organs is seen in nutritive factors most prominently, minor ones being temperature, moisture, light, etc.; and illustrations are given to show how such factors would affect several regions simultaneously. The last section deals with "Unit-characters," and is a most fundamental speculation from the standpoint of evolution. Each organism is conceived of as a "microcosm, consisting of thousands of elementary entities, which combine to give it its form and function." These are the units which govern and control the visible characters and qualities. The larger the number of common units and the smaller the number of different units, the greater will be the affinity. As to the nature of a "unit," there are two points of view. They may be approached by analyzing the visible characters and reducing them to independent groups; or there may be some invisible, although material cause, which constitutes the real source of each unit. There is no reason to assume that a unit should be limited to one organ, to one tissue, or to one cell. A unit may show its activity in different organs, sometimes even in almost all parts of a plant. This explains correlations and "has overwhelming importance in hybridism." Crosses give insight into the nature of unit-characters, showing what marks belong together, and dividing so-called characters into their constituent units. When one unit is added to or subtracted from a well-known type, the result is a mutation. The author is impressed with the idea that the study of correlations must be conducted on the broadest possible lines, and that in this direction we shall approach some definite knowledge of evolution.

The last topic is "The geographical distribution of plants" and is chiefly an expression of doubt as to the real value of the current ideas concerning the nature of adaptations of organisms to their environment. For example, the current view of desert plants is that they are "astonishingly specialized and adapted for large regions where it is impossible for other plants to thrive." It is a natural

inquiry, however, whether all these species are natives of the desert and have acquired their special characters under the influence of their environment. "Is it the desert which has made them what they are, or are they perhaps only a selected few from among the widely differentiated forms which are everywhere abundant on more favorable soils?" Present distribution is the result of migration, and migration is directed by the given characters of the species. The qualities of organisms are the causes, and the distribution is the result.

Altogether, the book is full of pregnant suggestions, and should do much toward clearing up some of the evident confusion concerning the views of the distinguished author.—J. M. C.

Progressus Rei Botanicae

Genetics.—In the valuable series of botanical reviews published by the Association Internationale des Botanistes under the title *Progressus rei botanicae*, BATESON[2] traces the progress made in the study of heredity by the pedigree-method since the rediscovery of MENDEL'S principles. For this discipline, which has so rapidly advanced to a place of prominence among the biological sciences, he proposes the name *genetics*.

The expressed object of the author, "to give an account of the progress in the study of heredity and variation which has followed the rediscovery of MENDEL'S work," has been carried out in a full and complete way, except for the notable omission of all but a passing reference to biometrical work, which has also made good progress during the same period, and which also belongs, at least in large measure, in the field of genetics. This omission is evidently due to the desire on the part of the author to avoid everything of a controversial nature. The literature of Mendelian heredity is fully cited and discussed, and the bibliography appended includes 140 titles. Certainly no one could have been selected to present the side of genetics represented by Mendelian hybridization, who is in position to speak with more authority than BATESON, and this summary of the literature to the early months of 1906 is of great value to all interested in the general subject.—G. H. SHULL.

Immunity.—As an introduction to this part, by R. P. VAN CALCAR,[2] the fundamental principles of adaptability of plasmodia to rising concentrations of glucose and the general influence of chemotaxis are discussed. The reactions to toxic ferments by the cells of some plants, in consequence of which the cell walls increase in thickness, are considered in the sense of self-defense or immunity. Similar protective processes are described in reference to bacteria. From these general considerations the author proceeds to the more complex subject of immunity in the animal body. After briefly explaining the theory of phagocytosis of METCHNIKOFF, the immensely important work on hemolysis is given its proper

[2] BATESON, W., The progress of genetics since the rediscovery of Mendel's papers. Progressus rei botanicae 1:368–418. *figs. 24.* VAN CALCAR, R. P, Die Fortschritte der Immunetäts- und Specifitäts-Lehre seit 1870. *Idem*, pp. 533–642 *figs* 20. Jena: Gustav Fischer. 1907. *M.* 18 the volume.